REMARKS

Reconsideration of the above-identified application in view of the amendments above and the remarks following is respectfully requested.

Claims 1-54 are in this case. Claims 37-52 and 54 have been withdrawn from further consideration as being drawn to a non-elected invention. Claims 1-36 and 53, drawn to a composition useful for the formation of a passivating layer on a substrate, have been examined on the merits.

Claims 31-36 have been rejected under 35 U.S.C. § 101. Claims 1-18, 19-36, and 53 have been rejected under 35 U.S.C. § 103. Claims 7, 23, 31-36 have been rejected under 35 U.S.C. § 112, second paragraph. Claims 23-25 have been canceled herewith. Claim 1-12, 15, 30-36 and 53 have been amended herewith.

35 U.S.C. § 101 and 112, Second Paragraph, Rejections

In one particular, the Examiner has stated that claims 31-36 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 31-36 have been amended herewith.

Specifically, the Examiner has stated that the claim 31 provides for the use of a composition of claim 1 for forming a passivating layer on a.substrate, but, since the claim does not set forth any steps involved in the method/process, it is unclear what method/process applicant is intending to encompass. The Examiner has further stated that a claim is indefinite where it merely recites a use without any active, positive steps delimiting how this use is actually practiced.

The Examiner has further stated that claims 31-36 are rejected under 35 U.S.C. 101 because the claimed recitation of a use, without setting forth any steps involved in the process, results in an improper definition of a process, i.e., results in a claim which is not a proper process claim under 35 U.S.C. 101, and that claims 32-36 are rejected as being dependent upon claim 31.

Claim 31 has been amended so as to recite a method of forming a passivating layer on a surface, which comprises contacting the surface with the claimed composition.

Claim 32-36 have been amended accordingly, to recite a "method" in the preamble, instead of a "composition".

Support for this amendment is found, for example, on page 9, line 14-16 of the instant application.

Applicant submits that amended claim 31, and amended claims 32-36 depending therefrom, include active, positive steps delimiting the claimed method, and hence is in line with the requirements of both 35 U.S.C. 112, second paragraph and 35 U.S.C. 101.

In another particular, the Examiner has stated that claims 7 and 23 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The Examiner's rejection is respectfully traversed.

Claim 23 has been canceled herewith. Claim 7 has been amended herewith.

Specifically, the Examiner has stated that the term "more positive" in claim 7 is a relative term which renders the claim indefinite, and that the term "more positive" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

Applicant wishes to point out that in aqueous solutions, the oxidation potential is the tendency of species in a solution to either gain or lose electrons, and the solution with a lower (more positive) oxidation potential will have a tendency to gain electrons, while the solution with a higher (more negative) oxidation potential will have a tendency to lose electrons. These relations and terms are known to any skilled artisan of the art.

Applicant wishes to note that the parameter denoted P_{pH}, as used in the instant application and in claim 7, is a potential value in volts, and it is given the formula $-0.05 \times pH + 0.425$, namely it is a function of the pH of the composition. Therefore, Applicant contends that the use of a relative term clearly defines the scope of the invention in this regard.

Notwithstanding the above, Applicant has chosen to amend claim 7 so as to more clearly define the scope of the claimed invention, and hence to replace the term

"more positive" with the term "lower than" and replace the unit V with the word "volt".

In order to be in line with the aforementioned amendments, Applicant has chosen to amend accordingly claims 8, 9, 10, 11, 12 and 53, so as to recite "lower than" instead of "more positive" and "volt" instead of "V".

Applicant believes to have overcome the Examiner's rejection in this regard.

The Examiner has further stated that the term "substantially" in claim 23 is a relative term which renders the claim indefinite, and that the term "substantially" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. The Examiner has further stated that by the term "substantially", it is not clear whether minor amounts of film-forming agent is permitted or no amount of a film-forming agent should be present.

Claim 23 has been canceled, thereby rendering moot the Examiner's rejection with respect thereto.

It is noted, however, that the limitations of claim 23 have been added to amended claim 1 (as detailed hereinbelow), and that amended claim 1 does not recite the controversial term "substantially".

35 USC § 103 rejection

Brusic Kaufman et al. alone or in view of Haggart et al.

The Examiner has stated that claims 1-12, 23-36 and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,447,371 (Brusic Kaufman *et al.*) alone or in view of U.S. Patent No. 6,589,099 (Haggart, Jr. *et al.*). The Examiner has further stated that although claims 31-36 are use claims, they are still being incorporated into this rejection. The Examiner's rejection is respectfully traversed. Claims 23-25 have been canceled herewith. Claim 1-12, 31-36 and 53 has been amended herewith.

Specifically, the Examiner has stated that Brusic Kaufman *et al.* teach a first and a second CMP slurries, wherein the first CMP slurry, having a pH of from about 2.0 to about 12.0, comprises an oxidizing agent such as hydrogen peroxide, or a permanganate, etc., an abrasive such as silica, alumina, or others in an amount of 0.5

to 15.0 wt % (column 3, lines 44-51; column 5, lines 17-33; column 7, lines 15-21; column 9, lines 29-38) wherein said slurry forms a passivation layer on the substrate (column 5, lines 55-56). The Examiner has noted that the reference also discloses applying said slurry onto substrates such as copper substrates to oxidize the copper to copper oxide (column 4, lines 24-27, 50-53, and 60-67).

The Examiner has further stated that the reference discloses overlapping ranges of amount of abrasive and pH of the slurry with the ones instantly claimed, and that overlapping ranges have been held to establish *prima facie* obviousness.

The Examiner has further stated that although the reference discloses the use of complexing agents in the slurry, it does not disclose the use of copper complexing agents; thus, said reference is seen to read on the limitation of claim 24.

The Examiner has further stated that the reference is seen to read on the limitation of instant claim 23 motivated by the fact that the reference makes it clear that the use of a number of additives such as film-forming agents is optional.

The Examiner has further stated that with reference to the limitations drawn to oxidation potential of the slurry, it should be noted that the reference discloses a CMP slurry having an overlapping range of pH containing similar abrasives and oxidizers used for polishing copper substrate by forming a passivation layer onto said substrate; therefore, the oxidation potentials as recited in claims 1 and 7-12 are seen to naturally follow from the composition of the disclosed slurry of Brusic Kaufman *et al.* absence clear and specific evidence showing why said reference composition does not have or could not impart an oxidation potential which would meet the limitation of claims 7-12 and that of claim 1.

The Examiner has stated that in the alternative, it would have been obvious to one of ordinary skill in the art through routine experimentation in the art in order to optimize the oxidation potential based on the intended polishing rate since a reduction in oxidation potential would slow down the polishing rate as is known in the art and as depicted by Haggart *et al.* in column 3, lines 36-40.

The Examiner has further stated that with reference to the composition being devoid of ammonium, it is noted that even though the reference may disclose the use of surfactant such as sulfate ammonium salts, or the use of pH adjusters such as ammonium hydroxides or the use of oxidizing agents such as ammonium cerium

nitrate, they are all embodiments of the reference and none of them are components that must be present in the disclosed CMP slurry, and thus, the reference is seen to reasonably read on the limitation of claim 25 taking those of embodiments that do not include the use of ammonium cations.

The Examiner has further stated that with reference to copper and copper oxide not being soluble in the slurry as that recited in claim 1, it is to be noted that it's the Examiner's position that copper and copper oxide are not soluble in the CMP slurry of Brusic Kaufman *et al.* since said reference does not disclose any solubility of copper or copper oxide in any of the disclosed CMP slurries.

The Examiner has further stated that with reference to the substrate or the surface to be polished to include more than about 5%, 10%, 40%, 50%, or 80% of copper by weight, it is to be noted that Brusic Kaufman *et al.* teach that the first CMP slurry, as detailed out above, is used to polish a copper containing substrate and to oxidize the copper to copper oxide (column 4, lines 24-27 and 60-67); thus, since the reference is silent to the presence of any other component other than copper in the copper containing substrate, it is the Examiner's position that said substrate contains, to a large extent, of copper, and therefore, the reference is taken to read on instant limitation absence clear evidence showing that said reference does not contain more than about 5%, 10%, 40%, 50%, or 80% of copper.

Before referring to the reference and allegations raised by the Examiner, Applicant wishes to note the following:

Embodiments of the invention relate to a novel CMP slurry composition which is advantageous over presently known CMP compositions by providing an improved copper passivation process, afforded by substances having pH above 9. Hence, the composition, according to embodiments of the invention, has a pH that is maintained above pH 9. The composition taught in the instant application circumvents the need to use copper-complexing agents such as ammonium cations. The unique characteristics of the CMP composition according to embodiments of the invention, which give rise to this improved passivated layer, are afforded by avoiding the solubilization of copper and copper oxide therein by film-forming agents, copper complexing agent and any other agents that contain ammonium cations, which are

known to solubilize copper and/or copper oxide. This concept is presented, for example, in the description on page 13, lines 4-13, of the instant application.

As mentioned in the introduction section of the instant application, a few compositions having a basic pH have been discussed in the art, however these compositions involve the use of ammonium cations, which are known to form complexes with copper and form soluble copper ammonium salts (*e.g.* $Cu(NH_3)_2$), which are dissolved by the slurry, in a manner analogous to the removal of copper metal by acidic slurries with many known disadvantages which the present invention overcomes.

Brusic Kaufman *et al.* teach surface treatment of copper/tantalum substrates using two distinct slurries, referred to therein as a first slurry for treating the copper portion of the substrate (see, column 4, lines 55-57 in Brusic Kaufman *et al.*) and a second slurry for treating the tantalum portion of the substrate (see, column 7, lines 25-28 in Brusic Kaufman *et al.*). It is noted herein that the only composition which is relevant to the present invention is the first slurry of Brusic Kaufman *et al.*, and therefore any reference to Brusic Kaufman *et al.* in the context of the instant application should relate only to this composition.

Applicant contends that Brusic Kaufman *et al.* mentioned in passing that the pH of their slurries can be raised up to 9 and even 12, but such high pH slurries are not actually taught. In fact, Brusic Kaufman *et al.* emphasizes that the preferred pH of the first slurry for passivating copper should be in the range of 4 to 8, as stated on column 7, lines 17-18, namely below pH 9, while the instant application teaches that the slurry for treating copper should have pH 9 or higher. For further clarity, Brusic Kaufman *et al.* emphasizes that the most preferred pH of the second slurry for treating tantalum-containing substrates should be in the range of 4 to 7.5, as stated on column 9, lines 25-27.

Furthermore, all the slurries of Brusic Kaufman *et al.* actually practiced exhibit a neutral pH of 7. Specifically, the compositions practiced according to the teachings of Brusic Kaufman *et al.* have pH 7, as stated clearly in all the examples Brusic Kaufman *et al.* provides, such as Example 1 on column 12, lines 40-41, Example 2 on column 13, lines 37-39, and the last Example 3, Table 4 on column 14,

where the three provided slurries are adjusted to pH 7, 6 and 5 respectively, namely *acidic* slurries , no less.

In addition, the slurries practiced in Brusic Kaufman *et al.* not only do not motivate any artisan to seek basic slurries for treating copper substrates as obvious alternatives, but rather teach away from basic slurries by using predominantly acidic components such as hydrogen peroxide and tartaric acid, which must be adjusted by considerable amounts of ammonium hydroxide in order to bring them up to less acidic or neutral pH (see, Example 1 on column 12, Example 2 on column 13 and Example 3, Table 4 on column 14).

Further still, Brusic Kaufman *et al.* are completely silent with respect to avoiding copper complexing agents such as ammonium species since they practice only acidic or neutral slurries as shown above, and go to the extent of teaching away from this concept by teaching pH adjustments of the acidic ingredients of their CMP slurries, by ammonium hydroxide, and the use of cerium nitrate as an oxidizing agent, dodecyl sulfate ammonium salt as a surfactant, and other amines as pH adjusting agents and ammonium salts as general additives. For another example, Brusic Kaufman *et al.* state that a preferred film forming agent for both the first and the second slurries taught therein, is benzotriazole (BTA, a complexing agent often used as a corrosion inhibitor)(see, for example, column 6, lines 26-38; column 8, lines 29-46; and slurries 2 and 3 of Example 3, Table 4 on column 14). BTA is known to act as an effective copper-complexing/passivating agent in acidic conditions, but not in basic solutions, such as those provided in the instant application.

Applicant wishes to note that these types of CMP slurries were discussed in the Background section of, and throughout, the instant application with clear references to their inferior capacity to passivate copper with acceptable results.

Further, since Brusic Kaufman *et al.* are completely silent with respect to a limiting oxidation potential of their slurries, Brusic Kaufman *et al.* do not provide motivation to arrive at the limitations taught by the Applicant, neither the motivation to correlate the oxidation potential of the slurry to its pH, based on a Pourbaix diagram (see, page 10, line 22, to page 11, line 14) and arrive at the limitation presented in claim 7.

It is evident that other than mentioning in passing that their slurries may have a pH in the range of 2-12, Brusic Kaufman *et al.* teach and practice away from the present invention in almost every facet of their copper-passivating slurries.

Applicant contends that although a reduction in oxidation potential would slow down the polishing rate as depicted by Haggart *et al.*, the fact that Brusic Kaufman *et al.* practice away from basic slurries and by practicing copper-complexing agents such as ammonium cations in Brusic Kaufman *et al.*, slurries which could be contemplated by combining Haggart *et al.* and Brusic Kaufman *et al.* would not afford the desired results which are obtainable by the presently disclosed slurries.

Notwithstanding the above, and in order to more clearly distinguish the claimed subject matter from the teachings of Brusic Kaufman *et al.*, alone or in view of Haggart *et al.*, Applicant has chosen to amend claim 1 so as to include the limitations in claims 23-25, reading on the slurry being devoid of film-forming agent, copper complexing agent and ammonium cations.

It is therefore the Applicant's opinion that the presently claimed invention is not rendered unpatentable over Brusic Kaufman *et al.* alone or in view of Haggart *et al.*, and is therefore allowable.

35 USC § 103 rejection

Brusic Kaufman et al. in view of Haggart et al. and Shimazu et al.

The Examiner has stated that claims 13-17 and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brusic Kaufman *et al.* alone or in view of Haggart, Jr. *et al.* as applied to claim 1 above, and further in view of U.S. Patent Application Publication No. 2002/0017064 (Shimazu *et al.*). The Examiner's rejection is respectfully traversed.

Specifically, the Examiner has stated that Brusic Kaufman *et al.* alone or in view of Haggart, Jr. *et al.* disclose a CMP slurry having a pH of from about 2.0 to about 12.0, oxidizers such as permanganates, abrasives such as silica and alumina as detailed above, and although Brusic Kaufman *et al.* disclose the use of pH adjusters such as bases to adjust the pH, said reference does not expressly disclose that said base may be potassium carbonate.

The Examiner has further stated that it would have been obvious to one of ordinary skill in the art to modify the polishing composition to have included a pH adjuster such as potassium carbonate to control the rate of polishing copper substrate since bases such as potassium carbonate affects the rate of polishing copper by adjusting pH as that taught by Shimazu *et al.*, and that it would have been obvious that the two references are drawn to the same field of endeavor.

As argued above, Applicant contends that Brusic Kaufman *et al.*, alone or in view of Haggart, Jr. *et al.*, do not teach or motivate to arrive at the presently claimed invention.

Shimazu *et al.* teach a polishing composition comprising an alkaline substance which includes KOH or hindered amines. Applicant wishes to note that the nitrogen functionality in hindered amines is surrounded by sterically-hindering atomic environment. By teaching hindered amines as pH adjusters, Shimazu *et al.* teach away from the present slurries as presently claimed since hindered amines are known to form stable complexes with copper and in fact are used to dissolve copper oxide. Furthermore, Shimazu *et al.* teach the use of KOH which is not formed from an alkali cation and a weak acid anion, as taught in the instant application and claimed in claims 13-17.

It is therefore the Applicant's opinion that the presently claimed invention is not rendered unpatentable over Brusic Kaufman *et al.* alone or in view of Haggart *et al.* or Shimazu *et al.*, and is therefore allowable.

35 USC § 103 rejection

Brusic Kaufman et al. in view of Haggart et al., Shimazu et al. and Parker et al.

The Examiner has stated that claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Brusic Kaufman *et al.* alone or in view of Haggart, Jr. *et al.* and in further view of Shimazu *et al.* as applied to claims 1 and 13 above, and further in view of U.S. Patent Application Publication No. 2003/0212283 (Parker *et al.*). The Examiner's rejection is respectfully traversed.

Specifically, the Examiner has stated that Brusic Kaufman *et al.* as evidenced by Haggart *et al.* and in further view of Shimazu *et al.* disclose a CMP slurry having a

pH of from about 2.0 to about 12.0, oxidizers such as permanganates, abrasives such as silica and alumina as detailed above.

The Examiner has further stated that even though the references as combined may not expressly disclose the use of cesium carbonate to adjust pH, the use of such compound to adjust pH would have been within the scope of a skilled artisan motivated by the fact that cesium carbonate is also a known alkali metal compound utilized in adjusting pH as that shown by Parker *et al.*; furthermore, Parker *et al.* teach the use of other compounds such as potassium carbonate in order to adjust pH in a solution, thus, suggesting that potassium carbonate and cesium carbonate are functionally equivalent, and that it is well settled that the substitution of one functionally equivalent compound for the other is well within the scope of the skilled artisan absence clear evidence showing the contrary.

Parker *et al.* teach the activation or regeneration of a catalyst involving contacting a fresh catalyst or a deactivated catalyst with ozone. Parker *et al.* does not teach any CMP slurries or even any copper-related chemistry. Applicant contends that the mere inclusion of potassium carbonate and cesium carbonate in a list of potential pH adjusters does not provide any motivation to combine the teachings if Parker *et al.* with any other art that relates to CMP compositions. Applicant contends that Parker *et al.* do not teach substituting reagents for achieving a solution having pH greater than 9 for passivating copper, and therefore Parker *et al.* cannot be used as related art in combination with other references.

It is therefore the Applicant's opinion that the presently claimed invention is not rendered unptanetable over Brusic Kaufman *et al.* alone or in view of Haggart *et al.*, Shimazu *et al.* or Parker *et al.*, and is therefore allowable.

35 USC § 103 rejection

Brusic Kaufman et al. in view of Haggart et al. and Watts et al.

The Examiner has stated that claims 21 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brusic Kaufman *et al.* alone or in view of Haggart, Jr. *et al.* as applied to claim 1 above, and further in view of U.S. Patent No. 5,897,375 (Watts *et al.*). The Examiner's rejection is respectfully traversed.

Specifically, the Examiner has stated that Brusic Kaufman *et al.* as evidenced by Haggart *et al.* disclose a CMP slurry having a pH of from about 2.0 to about 12.0, oxidizers such as permanganates, abrasives such as silica and alumina as detailed above.

The Examiner has further stated that although Brusic Kaufman *et al.* as evidenced by Haggart *et al.* disclose the use of permanganates oxidizers, they do not expressly disclose the use of an oxidizer such as potassium permanganate; but nevertheless, it would have been obvious to one of ordinary skill in the art to utilize potassium permanganate as the permanganate oxidizer used in Brusic Kaufman *et al.* as evidenced by Haggart *et al.* motivated by the fact that not only Brusic Kaufman *et al.* disclose that permanganates are utilized in their slurry as oxidizer, but also, motivated by the fact that Watts *et al.* clearly teach that potassium permanganate is a known industrial oxidizer used in CMP slurry utilized to polish copper layers (see, Abstract in Watts *et al.*).

As argued above, Applicant contends that Brusic Kaufman *et al.*, alone or in view of Haggart, Jr. *et al.*, do not teach, or motivate to arrive at, the presently claimed invention.

While Watts *et al.* teach CMP slurry using potassium permanganate as an oxidizer, Watts *et al.* also teach the use of ammonium cations and copper-complexing agents such as triazoles, and, as argued hereinabove, by that preclude motivation to arrive at the claimed invention, and in fact teach away from the presently claimed CMP slurries.

It is therefore the Applicant's opinion that the presently claimed invention is not rendered unpatentable over Brusic Kaufman *et al.* alone or in view of Haggart *et al.* or Watts *et al.*, and is therefore allowable.

Additional Amendments

Applicant has chosen to introduce additional amendments to the claims so as to improve the readability thereof.

Thus, claims 1-11, 15 and 30-37 have been amended so as to longer recite the term "about". Claim 15 has been further amended so as to omit the word "of".

In view of the above amendments and remarks, it is respectfully submitted that amended claims 1-12, claims 13 and 14, amended claim 15, claims 16-22 and 26-29, and amended claims 30-36 and 53 are now in condition for allowance. Prompt notice of allowance is respectfully and earnestly solicited.

Respectfully submitted,

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Date: July 23, 2009

Enclosures:

- Petition for Extension (one month)